

1. The solute potential of this sucrose solution can be calculated using the following formula:

$$\psi_s = -iCRT$$

where **i = Ionization constant** (for sucrose this is 1.0 because sucrose does not ionize in water)

C = Molar concentration (determined from your graph – see your potato data)

R = Pressure Constant ($R = 0.0831$ liter bars/mole $^{\circ}\text{K}$)

T = Temperature ($^{\circ}\text{K}$) ($273 + ^{\circ}\text{C}$ of solution)

The units of measure will cancel as in the following example:

A 1.0 M sugar solution at 22°C under standard atmospheric conditions

$$\psi_s = -i \times C \times R \times T$$

$$\psi_s = -(1)(1.0 \text{ mole/liter})(0.0831 \text{ liter bar/mole K})(295 \text{ K})$$

$$\psi_s = -24.51 \text{ bars}$$

2. Knowing the solute potential of the solution (ψ_s) and knowing the pressure potential of the solution is zero ($\psi_p = 0$) allows you to calculate the water potential of the solution. The water potential will be equal to the solute potential of the solution.

$$\Psi = 0 + \psi_s \text{ or } \Psi = \psi_s$$

The water potential of the solution at equilibrium will be equal to the water potential of the potato cells. What is the water potential of the potato cells? Show your calculations here:

3. Water potential values are useful because they allow us to predict the direction of the flow of water.

Suppose that a student calculates the water potential of a solution inside a bag to be -6.25 bar ($\Psi_s = -6.25$, $\Psi_p = 0$) and the water potential of a solution surround the bag is -3.25 bar ($\Psi_s = -3.25$, $\Psi_p = 0$). In which direction will the water flow?

Water will flow into the bag. This occurs because there are more solute molecules inside the bag (therefore a value further away from zero) than outside the solution.

Analysis Questions

1. If a potato core is allowed to dehydrate by sitting in open air, would the water potential of the potato cells decrease or increase? Why?

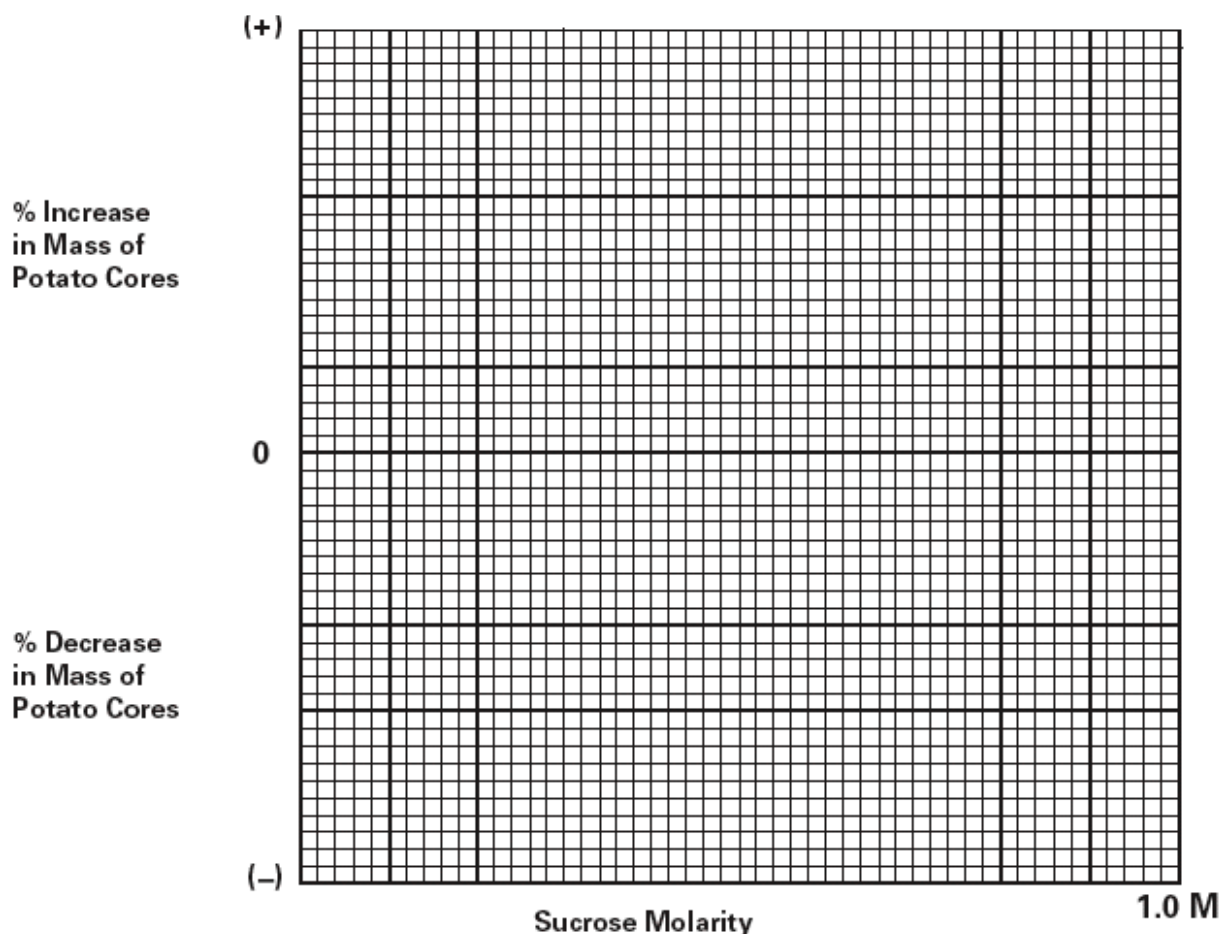
2. If a plant cell has a lower water potential than its surrounding environment and if pressure is equal to zero, is the cell hypertonic (in terms of solute concentration) or hypotonic to its environment? Will the cell gain water or lose water? Explain.

3. Zucchini cores placed in sucrose solutions at 27°C resulted in the following percent changes after 24 hours:

% Change in Mass	Sucrose Molarity
20.0%	Distilled water
10.0%	0.2 M
-3.0%	0.4 M
-17.0%	0.6 M
-25.0%	0.8 M
-30.0%	1.0 M

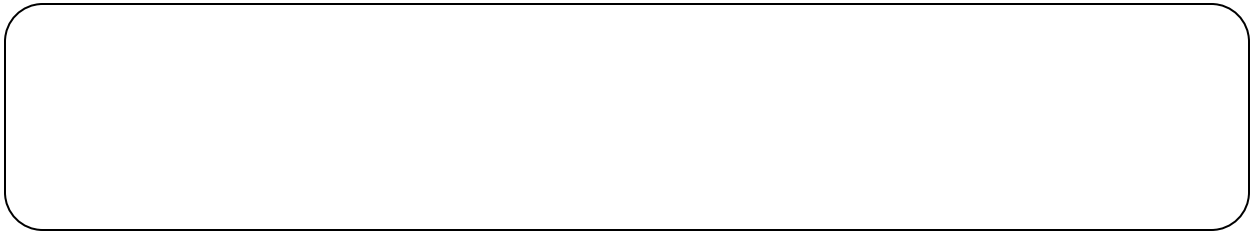
Graph the results and determine the molar concentration of solutes within the zucchini cells.

Figure 1 Title: _____



Solute concentration of zucchini: _____

4. Calculate the solute potential of the solutes within the zucchini cores does not change. Show your work!!



5. What is the water potential for a sucrose solution that is 0.1M? (temperature of 22°C) Show your work.

6. What is the solute potential for a sucrose solution that is 0.5M? (temperature of 0°C) Show your work.

7. Calculate the osmotic potential (Ψ_s) of a 2.4 molar sucrose solution at 24°C. Show your work.

8. It's April 14, 1912 and your journey on the unsinkable ship the Titanic is coming to an end. Luckily, you were one of the few souls to gain a seat in a life boat and as you watch the great ship tip up, then break in half and sink you are hit with a feeling of being thirsty. In the rush to get to safety no one thought to pack provisions into the lifeboat. Day after day your little party floats along in the frigid artic air and your thirst begins to feel unquenchable. People are starting panic and experimenting with drinking seawater to quench their thirst. You're not sure this is a good idea so you decide to solve a couple of water potential problems, while waiting for rescue, to determine if drinking sea water is a good idea or not.
- The majority of dissolved ions in seawater is NaCl, roughly a 0.5 M NaCl concentration. The ionization constant for NaCl is 2.0. Calculate the solute potential for seawater if you know that the water is -5°C.
 - Your own cells have a 0.15 M NaCl concentration. Calculate the solute potential for your own cells, knowing that body temperature is 37°C.

- c. Using the formula for calculating water potential in what direction will water flow if a person drinks the very cold seawater? Explain.

- d. Is drinking seawater a good idea for survival? What effect will drinking seawater have on you and your chances of surviving until you are rescued?
